

REMARKS/ARGUMENTS

This is a Response to the Office Action mailed February 10, 2004, in which a three (3) month Shortened Statutory Period for Response has been set, due to expire May 10, 2004. Thirty-three (33) claims, including seven (7) independent claims, were paid for in the application. Claim 1 has been canceled. Claims 2-6, 28 and 30 have been amended. No new matter has been added to the application. Enclosed is our check to cover the fee for one additional independent claim due by way of this Amendment. The Director is authorized to charge any additional fees due by way of this Amendment, or credit any overpayment, to our Deposit Account No. 19-1090. Claims 2-33 are pending.

Claim Suggestions

Claims 4 and 28 are corrected by the amendments above as suggested by the Examiner.

Objections

Claims 2, 4, 25 and 31 were objected to as being dependent on a rejected base claim. Claim 2 has been rewritten in independent form to include all limitations of the base claims and any intervening claims. Claim 4 has been amended to depend from claim 2. Claims 2 and 4 are thus allowable. It is noted that in rewriting the claims in independent form, the scope of the claims has not changed and the amendment should not be considered as narrowing the scope of claims 2 and 4.

35 U.S.C. §102(b) Rejections

Claims 1, 3, 5, 24, 26-27 and 29 were rejected under 35 U.S.C. §102(b) as being anticipated by Summers et al. (U.S. Patent No. 3,808,534), as evidenced by the article entitled "semiconductor device" (Encyclopedia Britannica).

Claim 1 is canceled, and claims 3 and 5 are amended to depend from allowable claim 2. The rejection of independent claims 24 and 30, as well as claims 26-27 and 29 which depend from claim 24, are addressed immediately below.

U.S. Patent No. 3,808,534 (hereinafter Summers) is generally directed to a circuit for monitoring voltage across groups of fuel cell stacks. The device taught by Summers provides a warning or shuts down the entire series of fuel cells if a malfunction occurs in any cell within a stack, for example, a short circuit or a cell reversal. Summers, Abstract; col. 1, lines 33-40. In particular, Summers teaches a fuel cell monitor that compares the voltages produced by each of a series of fuel stacks *to one another* in order to monitor their outputs. Summers, Abstract; col. 1, lines 41-55; col. 2, lines 10-16; col. 4, lines 29-35; col. 4, line 66-col. 5, line 2; col. 5, lines 43-48 and 60-63. While Summers teaches that the fuel cell stacks may be electrical sub-divisions of a large fuel cell stack (Summers, col. 2, lines 43-45), the comparison is always between voltages across adjacent sets of fuel cell stacks.

Importantly, Summers teaches producing an indication if the *difference* between voltages across adjacent fuel cell stacks is greater than a threshold voltage. Thus, Summers does not teach or suggest "producing a first indication when the voltage across the fuel cell structure is greater than a threshold voltage; and producing a second indication, different from the first indication, when the voltage across the fuel cell structure is not greater than the threshold voltage" as recited by claim 24, *inter alia*. Similarly, Summers does not teach or suggest "producing a first indication when the voltage across each of the first and the second sets of at least two fuel cells in the fuel cell stack is greater than a threshold voltage; and producing a second indication when the voltage across any of the first and the second sets of at least two fuel cells in the fuel cell stack is not greater than the threshold voltage" as recited by claim 30, *inter alia*.

Claim 30 was rejected under 35 U.S.C. §102(b) as being anticipated by EP 982788.

EP 982788 teaches electrically coupling a light emitting diode of an optoisolator across a pair of fuel cells, and thus fails to teach or suggest "monitoring a voltage across a first set of at least two fuel cells in the fuel cell stack with at least a first transistor electrically coupled across the first set of at least two fuel cells" and "simultaneously monitoring a voltage across a second set of at least two fuel cells in the fuel cell stack with at least a second transistor electrically coupled across the second set of at least two fuel cells" as recited by amended claim

30. The advantages of a transistor over a diode are discussed below, with reference to the rejections under 35 U.S.C. 103(a).

Rejections Under 35 U.S.C. § 103

Claim 28 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Summers et al. (U.S. Patent No. 3,808,534). Claim 6 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Summers et al. (U.S. Patent No. 3,808,534) in view of Vitale et al. (U.S. Patent No. 6,066,408.)

In particular, claim 28 was rejected under the same rationale as claims 1, 3, 5, 24, 26, 27 and 29, and because the Examiner contends that while the Summers does not expressly reach the step of selecting the resistance of the first and second resistors (100, 98) to set the threshold voltage to a voltage in the range of 0.8-0.85V, such would have been obvious to one of ordinary skill in the art at the time of the invention. The Examiner supports this contention by stating that it is known that the number of fuel cells in an individual stack may be varied according to the needs of the artisan, as recognized by Summers, and that the artisan may reduce the number of cells and thus the total output voltage of each stack. The Examiner goes on to state that Summers teaches that the resistor 100 is adjustable so that the emitter voltage may be varied, thus providing sufficient guidance to adjust the voltage of the resistors as needed, based on the stack voltages and transistor activation voltages.

Applicant has addressed the rationale provided for rejecting claim 24 above, and reiterates such traverse of the rationale with respect to claim 28. Thus, the proposed modification would set the threshold for *the difference between voltages (e.g., $V_1 - V_2$) across adjacent sets of fuel cells (e.g., Cell₁ and Cell₂ = V_1 , and Cell₃ and Cell₄ = V_2), rather than the threshold for the voltage (V_1) across any individual set of fuel cells (e.g., Cell₁ and Cell₂ = V_1).*

Further, Applicant respectfully disagrees with the Examiner's contention with respect to the obviousness of the proposed modification of the teachings of Summers.

While Summers may teach that one skilled in the art can select the number of fuel cells in a fuel cell stack to adjust the voltage output of the fuel cell stack, and that a resistance in a voltage divider may be adjusted to vary the voltage level at which a transistor conducts, there is

no motivation in the art for monitoring across a pair of fuel cells using the particular threshold range recited in claim 28.

As discussed in the present application, Applicant has recognized that a fuel cell structure consisting of two fuel cell assemblies optimizes the cell voltage checker circuitry in terms of cost and performance. Employing a fuel cell structure having just a single fuel cell assembly requires twice as many voltage sensing components, while employing a fuel cell structure having more than two fuel cell assemblies lowers the resolution (*i.e.*, ability to detect a minimum voltage drop) of the cell voltage checker. This is particularly true of PEM fuel cell assemblies, where each fuel cell assembly produces a potential difference of approximately 0.6V across the anode and cathode, and a fuel cell structure with two such fuel cell assemblies produces an approximately 1.2V total potential difference.

Monitoring across pairs of fuel cell assemblies takes advantage of the inherent characteristics of most commercially available transistors, which have a trigger or threshold voltage of approximately 0.85V. Where there is an approximately 0.6V potential across each fuel cell assembly, a transistor provides adequate resolution for detecting an operationally significant drop in voltage across a pair of fuel cells having a total nominal potential of 1.2V. The transistor provides an inherent advantage over other electronic components which do not have thresholds that provide as suitable a resolution. For example, commercially available light emitting diodes ("LEDs") or optoisolators have a trigger or threshold of approximately 1.4-1.6 V. As discussed above, there are advantages in cost, structural simplicity, and monitoring effectiveness to monitoring voltage across pairs of fuel cells using transistors, rather than across individual fuel cell assemblies and/or larger groups of fuel cell assemblies.

Summers employs a fuel cell technology other than PEM fuel cells, as demonstrated by the assumption that the fuel cells produce 1V each. Summers, col. 4, lines 53-59. The advantages of using a transistor (*i.e.*, threshold approximately 0.8V-0.85V) for monitoring voltage across pairs of fuel cells (1.2V) is lost in such a situation. Thus, one of ordinary skill in the art would not be motivated to monitor voltage across pairs of fuel cells producing a combined potential of 2V using a transistor, nor to employ the specific threshold range recited in claim 28. This is further made clear by Summers' own teachings, in which their preferred embodiment divides one hundred fuel cells, into four stacks of twenty-five fuel cells

each, thus producing approximately 25V across each stack. Summers, col. 2, lines 41-45; col. 6, lines 26-31. Thus, even if PEM fuel cells were substituted, there is no motivation in the art for the recited combination of claim 28.

Claim 6 has been rewritten in independent form, and as rewritten recites, *inter alia*, "a pair of solid polymer fuel cells electrically connected to one another in series; and at least one pnp bipolar junction transistor having a base, an emitter and a collector, the transistor coupled to respond to a voltage across the pair of solid polymer fuel cells."

In a similar respect to that set out above, neither Summers, Vitale, nor a combination of Summer and Vitale teaches or suggests the combination of a bipolar junction transistor electrically coupled across a pair of PEM fuel cells as recited by rewritten claim 6. While Summers teaches that the circuit of Figure 2 may be expanded to monitor any number of fuel cell stacks, they do not suggest reducing the number of fuel cells in a stack to two, to achieve a desired resolution based on the threshold of commercially available transistors. Summers, col. 6, lines 26-31. The only suggestion for such comes from the Applicant's own teachings.

Conclusion

Applicant thanks the Examiner for allowing claims 7-23 and 32-33, and for indicating the allowable subject matter of claims 2, 4, 25 and 31. Overall, the cited references do not singly, or in any motivated combination, teach or suggest the claimed features of the embodiments recited in independent claims 2, 6, 24 and 30, and thus such claims are allowable. Because claims 3-5, 25-29 and 31 depend from allowable independent claims 2, 24 and 30, and because they include additional limitations, such claims are likewise allowable. If the undersigned attorney has overlooked a relevant teaching in any of the references, the Examiner is requested to point out specifically where such teaching may be found.

In light of the above amendments and remarks, Applicant respectfully submits that all pending claims are allowable. Applicant, therefore, respectfully requests that the Examiner reconsider this application and timely allow all pending claims. Examiner Crepeau is encouraged to contact Mr. Abramonte by telephone to discuss the above and any other distinctions between the claims and the applied references, if desired. If the Examiner notes any

Application No. 09/916,115
Reply to Office Action dated February 10, 2004

informalities in the claims, he is encouraged to contact Mr. Abramonte by telephone to expediently correct such informalities.

Respectfully submitted,

Seed Intellectual Property Law Group PLLC

A handwritten signature in black ink, appearing to read 'Frank Abramonte', is written over a horizontal line.

Frank Abramonte
Registration No. 38,066

Enclosure:
Postcard

701 Fifth Avenue, Suite 6300
Seattle, Washington 98104-7092
(206) 622-4900
Fax: (206) 682-6031

(FXA:lg) 481176_1